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# PATENT SPECIFICATION

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(19)


## (54) TENSIOMETERS

(71) We, DAVY-LOEWY LIMITED, a British company of Prince of Wales Road, Sheffield S9 4EX, Yorkshire, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a tensiometer for detecting the tension of moving strip material, such as metal strip travelling between successive stands of tandem mill. The signal form the tensiometer may be utilised to control one or other of the adjacent stands, as by adjusting the speed or the roll gap of the stand to maintain the tension substantially constant.

It has previously been proposed to employ as a tensiometer a pivoted arm which can be raised into contact with the moving strip and which carries a load detector responsive to the strip tension. That proposal is not altogether satisfactory in that excessive tension in the strip may result in damage to the load detector. In addition, the tensiometer is incapable in itself of re-establishing tension in the strip should the tension fall to a dangerously low level due to incorrect speed settings of the adjacent stands.

According to the present invention a tensiometer for strip material comprises a pivoted arm; first means for pivoting the arm from a retracted position to a predetermined working position, those positions being such that in use the arm is out of engagement with the strip in the retracted position and engages and applies force to the strip in the working position; second means operative on the arm to pivot the arm from the working position in the direction away from the retracted position; and a load cell arranged, at least when the arm is in its working position, to detect the load to which the arm is subject on engagement with the strip, and hence the strip tension.

The invention will be more readily understood by way of example from the following description of a strip tensiometer in accordance therewith, reference being made to the drawing accompanying the provisional specification, in which:—

Figure 1 shows, diagrammatically, a pair of rolling mill stands between which is located a tensiometer, and

Figure 2 shows the tensiometer in detail.

The tensiometer comprises a lever 2, which is rockable about a pivot 4. Arm 6 of the lever is in the form of an arm and carries at its outer end a strip engaging roller 8 which rotates about a pin 10. That same end of the arm 6 is formed with a downwardly extending lug 12. The lever 2 has a second, integral, arm 14 directed away from arm 6. The lever 2 is operated by first and second means constituted respectively by piston and cylinder assemblies 20, 18.

The piston and cylinder assembly 20 is located below the lug 12. The upper end of the piston of the assembly 20 carries a load cell 22 which is of conventional construction and which normally engages, but is not secured to, lug 12. A downwardly directed skirt 24 affixed to the load cell 22 is formed at its lower end with a ring 26 which slides on the cylinder of unit 20 and which is limited in upward movement by an annular stop 28 secured to the exterior of the cylinder.

The second piston and cylinder assembly 18 has its cylinder pivoted to a fixed point and its piston rod 16 pivotally secured to the extremity of arm 14 of lever 2.

The tensiometer is disposed approximately midway between stands $R_1$ and $R_2$ of a tandem mill (Figure 1). For the initial threading of the mill the piston of assembly 20 is lowered and the assembly 18 is operated to turn the lever in clockwise direction so that lug 12 follows the load cell 22, until roller 8 is in a retracted position below the straight pass-line between stands $R_1$, $R_2$. The tensiometer does not then hinder the threading operation.

When threading has been completed, fluid is supplied to the cylinder of assembly 20 to raise the piston from the retracted

position until the ring 26 abuts stop 28, cylinder 18 being vented. The engagement of ring 26 with stop 28 defines a working position of the tensiometer arm, which then has a predetermined inclination such that the roller 8 forces the strip S away from its normal pass-line. The tension in the strip exerts a downward force on the roller 8 and that force is transmitted to the load cell 22 by the lug 12, the signal from the load cell being used to control the speed of one mill stand with respect to that of the other mill stand, to ensure that the tension in the strip remains substantially constant.

For example, if the tension in the strip increases, the pressure of the lug 12 on the load cell 22 also increases and the resulting increase in the signal from the load cell causes the speed of the mill stand $R_2$ to decrease to reduce the tension in the strip. For that purpose the signal from the load cell may be compared with a datum signal and the speed of the stand or stands, and therefore the tension in the strip, is constantly adjusted to maintain the signal from the load cell substantially equal to the datum signal.

The pressure in the cylinder of the assembly 20 is so selected that the piston will retract in the cylinder if the tension in the strip exceeds a safe value beyond which damage could occur to the load cell 22 by the resultant pressure exerted on it through the lug 12.

If the tension in the strip falls to zero, the resulting signal from the load cell representing zero tension actuates a valve causing liquid under pressure to be fed to the assembly 18 to draw the piston into the cylinder. The lever 2 is rocked in an anti-clockwise direction, i.e. is moved from the predetermined working position in the direction away from the ambushed position, in order to re-establish tension in the strip; the position of the roller 8 when so elevated is shown in chain line in Figure 2 and it will be seen that the lug 12 is separated from load cell 22. The arm 2 then acts to restore tension in the strip.

Thus there is provided a tensiometer device, which has the added function of restoring strip tension when necessary, and in which the load cell is retracted downwardly when the tension in the strip exceeds an amount which can be tolerated with safety having regard to its effect on the pressure on the load cell.

The load cell 22 is not necessarily carried at the upper end of the piston of assembly 20; it may be disposed at some other location provided that it is subject to the force applied by the strip S to the roller 8. Thus, the load cell may be arranged between the journals of the roller 8 and the arm 6, the lug 12 then acting directly on the upper end of the piston of assembly 20 and that piston then carrying the skirt 24. Wherever the load cell is disposed it is protected by the assembly 20 from dangerous loads which when they arise force the piston to lower and thereby reduce the loading imposed on the load cell by the strip.

WHAT WE CLAIM IS:—

1. A tensiometer for strip material comprising a pivoted arm; first means for pivoting the arm from a retracted position to a predetermined working position, those positions being such that in use the arm is out of engagement with the strip in the retracted position and engages and applies force to the strip in the working position; second means operative on the arm to pivot the arm from the working position in the direction away from the retracted position; and a load cell arranged, at least when the arm is in its working position, to detect the load to which the arm is subject on engagement with the strip, and hence the strip tension.

2. A tensiometer according to claim 1, in which the first means comprise a piston and cylinder assembly, the movable part of which is adapted to engage, but is not connected to, the arm at a point displaced from the pivot point of the arm, and stop means limiting the displacement of that movable part to the working position.

3. A tensiometer according to claim 2, in which the fixed part of the piston and cylinder assembly carries the stop means and the movable part has a member adapted to engage with the stop means when the arm is in the working position.

4. A tensiometer according to any one of the preceding claims, in which the second means is a piston and cylinder assembly.

5. A tensiometer according to any one of the preceding claims in which the load detector is arranged normally to give a signal representing the load to which the arm is subject, and there are means, operated by a signal from the load detector representing substantially zero load, for energising the second means to move the arm from the working position.

6. A tensiometer according to any one of the preceding claims, in which the load detector is carried by the movable part so as to be engaged by the arm, but is separable from the arm.

7. A tensiometer according to claim 1 or claim 2, in which the load detector is carried by the arm.

8. A tensiometer for strip material, substantially as herein described, with reference to the drawings accompanying the provisional specification.

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1487396 PROVISIONAL SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

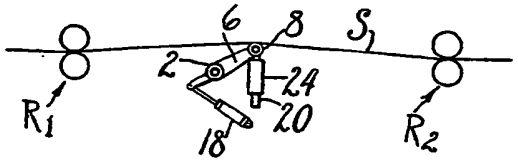


Fig. 1.

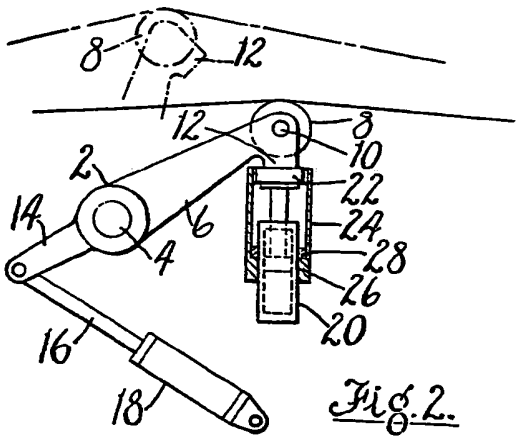


Fig. 2.